

**AMENDMENTS TO THE DRAWINGS**

Kindly replace Figure 1 with the enclosed replacement sheet for Figure 1.

## **REMARKS**

In an Office Action mailed September 11, 2009, claims 1-4 of the present application were rejected. Applicants respectfully request further examination and reconsideration of the application based on the following remarks.

Replacement sheet for figure 1 is provided to correct a clerical error labeling the illustrated curves of figure as correspond to the samples in table 1 of the specification.

Applicants note that the following illustrates the correct relationship between table 1 and original figure 1:

reference sample A of table 1 corresponds to curve G in original figure 1;  
reference sample B of table 1 corresponds to curve F in original figure 1;  
reference sample C of table 1 corresponds to curve C in original figure 1;  
reference sample D of table 1 corresponds to curve D in original figure 1;  
sample E according to the invention corresponds to curve A in original figure 1;  
sample F according to the invention corresponds to curve B in original figure 1; and  
sample G according to the invention corresponds to curve E in original figure 1.

Applicants respectfully submit that the replacement sheet for figure 1 correctly identifies the curves with the samples of table 1 (i.e., reference sample A of table 1 corresponds to curve A in replacement figure 1, etc.). Additionally, Applicants note that figure 1 of French Application 04 03038 (published as FR 2 868 083, to which the present application claims priority) clearly shows that the Jominy curves of the samples according to the invention in figure 1 of the French Application correspond to the Jominy curves of the samples of the invention in the replacement sheet for figure 1. Accordingly, Applicants respectfully submit that no new matter has been added.

A declaration under Rule 1.132 is provided. Applicants respectfully submit that the declaration, signed by one of the inventors in the present application, presents additional evidence for the patentability of the presently claimed invention. Applicants respectfully request that the content of the declaration be thoroughly considered in assessing the patentability of the presently claimed invention.

Claims 1-4 were rejected under 35 U.S.C. 103(a) as being unpatentable over Badard (WO 03/012156 A1, hereafter “Badard”). Applicants respectfully request reconsideration of the rejection based on following remarks.

Claim 1 recites, in part, steel for mechanical components, wherein the composition thereof is, in percentages by weight:  $0.19\% \leq C \leq 0.25\%$ ;  $1.1\% \leq Mn \leq 1.5\%$ ;  $0.8\% \leq Si \leq 1.2\%$ ;  $0.01 \leq S \leq 0.09\%$ ; trace levels  $\leq P \leq 0.025\%$ ; trace levels  $\leq Ni \leq 0.25\%$ ;  $1\% \leq Cr \leq 1.4\%$ ;  $0.10\% \leq Mo \leq 0.25\%$ ; trace levels  $\leq Cu \leq 0.30\%$ ;  $0.010\% \leq Al \leq 0.045\%$ ;  $0.010\% \leq Nb \leq 0.045\%$ ;  $0.0130\% \leq N \leq 0.0300\%$ ; and optionally trace levels  $\leq Bi \leq 0.10\%$  and/or trace levels  $\leq Pb \leq 0.12\%$  and/or trace levels  $\leq Te \leq 0.015\%$  and/or trace levels  $\leq Se \leq 0.030\%$  and/or trace levels  $\leq Ca \leq 0.0050\%$ .

The steel composition of the present invention lies within the range disclosed by Badard. However, the particular ranges of claim 1 **achieve an unexpected result** relative to the prior art range.

Applicants can rebut a presumption of obviousness based on a claimed invention that falls within a prior art range by showing that there are new and unexpected results relative to the prior art (MPEP 2144.05(III)). To establish unexpected results over a claimed range, applicants should compare a sufficient number of tests both inside and outside the claimed range to show the criticality of the claimed range (MPEP 716.02(d)(II)).

The steel composition of the present invention produces the unexpected result of a Jominy curve with no inflection point (Specification Pg.6). A composition of steel which produces a Jominy curve with no inflection point is advantageous for producing greatly reduced deformations during the quenching operation following a carburizing or carbonitriding operation (Specification Pg.6). The criticality of the composition ranges used to achieve the above Jominy curve, and a comparison of compositions of steel having elements within the claimed ranges to compositions of steel having elements outside the claimed ranges are discussed below.

## **I. Criticality of the Composition Ranges of the Present Invention**

Initially, Applicants note that on pages 7 and 8 of the Office Action, the Examiner appears to take the position that Applicants have failed to show unexpected results of the claimed ranges in producing a Jominy curve with no inflection point because the Examiner alleges that the specification merely discloses that the endpoints of the elements are stated to control hardness but not the Jominy shape. Applicants note that a Jominy curve is based upon measurements of the hardness of a material at different depths of the material. Accordingly, it follows that an element that has an influence on the value of the hardness of a material would have an influence on the shape of the Jominy curve for the material. With regard to steel, Applicants respectfully submit that the above is particularly true since a Jominy curve for a steel would result from **the combination of the influences of the various elements present in the steel.** Of course, each of the various elements has a different quantitative influence on the hardness value, and as a result, modifying the contents of some of the elements simultaneously has an influence on the shape of the Jominy curve.

In view of the above comments, Applicants respectfully submit that the previous Amendment filed on June 4, 2009 established the criticality of the ranges of claim 1 by citing support in the specification for the influence of the various elements of the steel according to claim 1. For convenience, Applicants restate the criticality of the ranges of claim 1 below.

The steel composition according to Badard discloses the carbon content to be between 0.12% and 0.30%, i.e.  $0.12\% \leq C \leq 0.30\%$  (Badard Pg.2). The carbon content of the present invention lies between 0.19% and 0.25%, i.e.  $0.19\% \leq C \leq 0.25\%$ . The specification discloses the criticality of the  $0.19\% \leq C \leq 0.25\%$  range stating:

“Furthermore, this range allows the contents of the other elements to be adjusted, which allows **the desired shape to be produced for the Jominy curve.** The minimum content of 0.19% is further justified by the core hardness which can be achieved thereby after

quenching. At more than 0.25%, there is a risk that the hardness will be too high to preserve the desirable machinability of the steel” (Specification Pg.8).

Additionally, the steel composition according to Badard discloses the chromium content to be between 0.4% and 1.6%, i.e.  $0.4\% \leq Cr \leq 1.6\%$  (Badard Pg.2). The chromium content of the present invention lies between 1% and 1.4%, i.e.  $1\% \leq Cr \leq 1.4\%$ . The specification discloses the criticality of the  $1\% \leq Cr \leq 1.4\%$  range stating:

“In this range...the **desired shape of the Jominy curve** can be produced. Furthermore, the minimum content of 1.00% allows a **high level of core hardness** to be produced. At more than 1.40%, the cost of production operation would be increased unnecessarily” (Specification Pg.10)

Further, the aluminium, niobium and nitrogen contents of the present invention are all narrower in range than the respective content ranges disclosed in Badard (See Office Action dated 2/05/2009, Pages 2-3). The specification discloses the criticality of the above content ranges stating:

“The aluminium, niobium, and nitrogen contents thereof must be controlled within **precise** limits. These elements which, when interacting, bring about control of the fineness of the metal grain. This fineness is desirable in order to produce a high level of strength in the carburized or carbonitrided layer, a high level of fatigue strength and a reduction of the dispersion of the deformation during quenching. Furthermore, it is also important for producing **the desired shape of the Jominy curve**” (Specification Pages 10-11) and,

“In conjunction with the contents of aluminium and niobium as mentioned, the nitrogen content must be between 0.0130 and 0.0300% (130 to 300 ppm) so that the desired adjustment of the grain size and **shape of the Jominy curve is produced**” (Specification P.12).

In view of the above, Applicants respectfully submit that the claimed ranges of the elements recited in claim 1 are critical to producing a composition of steel which produces a Jominy curve with no inflection point which is advantageous for producing greatly reduced deformations during the quenching operation following a carburizing or carbonitriding operation.

**II. Comparison of compositions of steel having elements within the claimed ranges to compositions of steel having elements outside the claimed ranges.**

Initially, Applicants note that an inflection point is a point on a curve where the concavity of the curve changes from a positive to a negative value or vice versa. For example, in the Office Action, the Examiner takes the position that curve E of original Figure 1 (now curve G of replacement Figure 1) has an inflection point at ~11mm. Applicants respectfully disagree and respectfully submit that, while curve E (curve G) changes at ~ 11mm, the curvature remains positive. Accordingly, curve E of original Figure 1 (now curve G of replacement Figure 1) does not have an inflection point at ~ 11mm.

As noted above, the presently claimed invention achieves the unexpected result of a Jominy curve with no inflection point resulting in a composition of steel which produces a Jominy curve with no inflection point is advantageous for producing greatly reduced deformations during the quenching operation following a carburizing or carbonitriding operation.

Additionally, Applicants note that replacement Figure 1 clearly indicates that the Jominy curves of steel samples (samples E, F, and G) according to the claimed invention lack any marked inflection points.

Further, Applicants note that among the reference steels tested and compared to the steels of the present invention, sample steels C and D (of replacement Figure 1 and Table 1) have compositions that fall into the ranges disclosed by Bedard but outside the ranges recited in claim 1; most notably steels C and D (of replacement Figure 1 and Table 1) contain a range of chromium (Cr) outside the claimed steel range (Specification Pg.13). Samples C and D (of replacement Figure 1 and Table 1) both produce Jominy curves with marked inflection points **owing to insufficient contents of chromium** (Specification Pg.14).

As stated above, a composition of steel which produces a Jominy curve with no inflection point is advantageous for producing greatly reduced deformations during the quenching

operation following a carburizing or carbonitriding operation. Thus, the ranges used by the present invention are **critical** to producing optimal Jominy curves for the steel compositions.

Based on the above remarks and the provided declaration under Rule 1.132, Applicants respectfully submit that claim 1 is patentable over Badard.

Further, claims 2-4 are patentable over Badard based at least on their dependency from allowable claim 1.

In view of the above, Applicants respectfully submit that claim 1, as well as the claims depending therefrom, is clearly allowable over the prior art of record.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the present application is clearly in condition for allowance. An early notice thereof is earnestly solicited.

If, after reviewing this Amendment, the Examiner feels there are any issues remaining which must be resolved before the application can be passed to issue, Applicants respectfully request that the Examiner contact the undersigned by telephone in order to resolve such issues.

Respectfully submitted,

Pascal DAGUIER et al.

/Stephen W. Kopchik/  
By: 2010.02.12 12:24:57 -05'00'

Stephen W. Kopchik  
Registration No. 61,215  
Attorney for Applicants

SWK/JRF/clw  
Washington, D.C. 20005-1503  
Telephone (202) 721-8200  
Facsimile (202) 721-8250  
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